A Strategy for Improving Interoperability of Weapon System Electronics

Volume 1. Executive Summary

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PREFACE

Improving the ability to reuse hardware and software in different types of weapon systems, and improving the ability of weapon systems to operate jointly, are two dimensions of improving the interoperability of weapon system electronics that are of high interest to the Department of Defense because such improvements (A) accelerate upgrading through the insertion of new technology, (B) reduce the acquisition and support costs for weapon systems, and (C) strengthen effective execution of joint operations. To achieve these three strategic goals, the DoD has separately employed three related tactics: (1) reduce the use of military specifications, (2) increase the reuse of hardware and software, and (3) improve the interoperation among weapon and C4I systems. Because the separate efforts to employ these tactics seems to be leaving some significant room for further improvement, this research is attempting to develop a unified strategy that might help improve the implementation of this set of related tactics.

Regarding the third tactic, the DoD has made recent progress by developing a Joint Technical Architecture (JTA) for C4I information management systems.[1] This research is exploring the hypothesis that the C4I technical architecture work might be extended and applied broadly to improve the three tactics that DoD is using to improve the interoperability of weapon system electronics. This work is reported in this volume and two companion volumes.[2]

This research was conducted for the Open Systems Joint Task Force established by the Undersecretary of Defense for Acquisition and Technology. It was conducted within the Acquisition and Technology Policy Center of RAND's National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies.

This draft report should be of interest to people with general interests in the acquisition process as well as those interested in the interoperability of weapon system electronics. This draft is being circulated to share the initial research results and to acquire comments and suggestions regarding this continuing work.

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[1] Command, Control, Communications, Computers, and Intelligence.
[2] Vol. 2, Strategy and Vol. 3, *Appendices (forthcoming)*.

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1. EXECUTIVE SUMMARY

To better sustain the superior warfighting effectiveness of the nation's weapon systems, the DoD is exploring new methods for improving the interoperability of weapon system electronics. By *interoperability of weapon system electronics* we mean both:

- The interchangeable use of hardware and software across many different kinds of weapon and commercial systems.
- The ability of weapon system electronics to operate effectively in support of joint operations.

The DoD has been employing three tactics to improve the interoperability of weapon system electronics:

Tactic 1: Reduce the use of military specifications
Tactic 2: Increase the reuse of hardware and software
Tactic 3: Improve interoperation of weapon and C4I systems

This research aims to help the DoD strengthen its employment of these tactics in order to produce better outcomes in terms of three strategic goals:

- Quick insertion of new technology
- Lower life-cycle costs for weapon system electronics
- More effective joint operations

By achieving these goals the DoD strengthens its ability to sustain the superior warfighting effectiveness of its weapon systems.

To help the DoD better realize such outcomes, this research is exploring the idea of developing and implementing a unified methodology that the Services and the defense agencies could use to construct technical architectures for their weapon systems electronics. There appear to be significant opportunities for such technical architectures to improve the DoD's employment of its tactics and thereby realize the following important improvements to outcomes.

Insertion of new technology is essential to sustaining superior combat effectiveness. DoD's ability to do this, however, is threatened by declining budgets and the faster pace of technical development in some parts of the commercial sector, notably computers and communications. There is a growing danger that adversaries may one day equip their forces with commercial technologies more advanced than those available to our forces.

Insertion of new technologies (both commercial and military) may be improved with the use of technical architectures for weapon system electronics that facilitate the reduction in military specifications (Tactic 1) and increase the reuse of hardware and software (Tactic 2). For example, replacing military specifications with appropriate commercial specifications would facilitate the insertion of new technologies that are developed for commercial applications. Furthermore, increasing the reuse of such hardware and software would lessen both the development and the production cost for inserting a new technology across weapon systems.

Lower costs for electronics is essential to sustaining the affordability of superior combat effectiveness in our nation's weapon systems. DoD's ability to lower these costs, however, is threatened by its growing dependence on electronics, and the rising complexity and costs of both hardware and software.

Lower costs for electronics **--** in general **--** may be realized with the use of technical architectures for weapon system electronics that facilitate the reduction in military specifications (Tactic 1) and aim to increase the reuse of hardware and software (Tactic 2). For example, costs could be reduced by using available commercial products and by reusing both military peculiar and commercial hardware and software in multiple applications.

Improved effectiveness of joint operations also is essential to sustaining superior combat effectiveness. Recent DoD studies have found that its ability to do this is threatened by inadequate coordination of both requirements and development for weapon system electronics.

Such coordination may be improved with the use of technical architectures for weapon system electronics that facilitate: the improvement of interoperation (Tactic 3), the reuse of hardware and software (Tactic 2), and the reduction of military specifications that inhibit the use of commercial products (Tactic 1). Interoperation that is important to the warfighter's mission success could be improved by standardization of interfaces and broad use of common hardware and software that has been matured through development and broad application.

To realize these benefits requires changes in the way that the DoD acquires weapon system electronics; the remainder of this report describes some ways to use a technical architecture to help accomplish such change.

BACKGROUND

The DoD has recently developed a Joint Technical Architecture (JTA) for C4I information management systems. The architecture identifies mandatory and emerging standards that the Services and defense agencies have agreed to use in developing future C4I capabilities. For implementation, the

DoD has assigned responsibility to the acquisition executives for the Services and defense agencies. However, the extent to which current systems are modified to conform to the mandatory standards in the JTA are uncertain. Although the acquisition executives have been directed to develop migration plans for their Service's/agency's systems, actual investments in modifications to existing systems will need broad support. For example, the Combatant CINCs, the Joint Staff, the Office of the Secretary of Defense (OSD), and the Congress will be involved in determining funding priorities for such migration. Until such priorities are resolved, the JTA's influence on current systems will be unknown. Thus, although the JTA seems to be a good start, it alone is not sufficient.

What the JTA does provide is standards for C4I information management systems that address five subject areas: information processing, information transfer, information modeling and information [representation], human computer interfaces, and information systems security. Each subject areas is divided into logical elements. For example, information processing includes an application software entity, and an application platform entity. For each entity and for the interface between the entities, the architecture identifies the functional services and the mandatory standards that should be adhered to in implementing the services. The Services and the defense agencies have agreed to adhere to these standards in developing new systems and in modifying existing systems.

As with migration, the matter of overseeing the conformance of new acquisition programs has been delegated to the Services and defense agencies. By making the Services and defense agencies responsible for implementation, the JTA for C4I sets forth only the "building codes" to which C4I systems must comply without specifying what will be built or how it will be built. The JTA for C4I also does not address how Services and defense agencies might cooperate in developing and modifying systems to minimize their joint costs.

APPROACH

This draft report builds upon DoD's recent progress in developing a technical architecture for C4I systems in two ways. First, the research described in the report is exploring the hypothesis that the C4I technical architecture work might be extended and applied to each of DoD's three tactics: reduce Mil Specs, increase reuse, and improve interoperation. To explore ways that the hypothesis might be developed and tested, we formulated the technical approach described below. The second way the report builds upon the JTA experience is by broadening the technical architecture concept to include non-technical matters such as the roles of institutions, the application of resources, and the schedule for development and implementation of new systems and modifications to existing systems. Such a holistic approach is intended to produce a technical architecture document that is a comprehensive and realistic basis for a contract among the participating parties.

To help accomplish that objective, this report

- Assesses the potential challenges to extending the C4I technical architecture approach to weapon system electronics.
- Analyzes past efforts that have addressed DoD’s three designated tactics (reduce Mil Specs, increase reuse, and improve C4I interoperation).
- Composes a methodology that: reflects lessons learned from past efforts, builds upon those past efforts that seem to offer the best potential for improving interoperability, and considers implementation needs.
- Imbeds the methodology in a broader strategy that provides for early pilot testing of concepts, rapid demonstration of promising procedures, and timely implementation of enhancements to DoD’s current strategy for improving interoperability.

FINDINGS

A number of challenges arose in extending the technical architecture concept beyond C4I to include improving the interoperability of weapon system electronics.

- Weapon systems, in general, have form, fit and function needs affecting hardware reuse that are not required for information systems and are not covered in the current JTA for C4I.
- The response time requirements on information processing for a weapon system are in general more demanding than those for C4I information systems. Consequently, the information management framework and standards in the JTA for C4I may be insufficient or inappropriate for a weapon system‘s information management.
- Interfaces within a weapon system can be hardware dependent when control algorithms depend upon models of how specific types of hardware operate. Consequently, substitution of a different hardware type may require verification that the substitution is compatible with the weapon system’s other hardware and software. Such verification may extend well beyond merely verifying that interface specifications have been satisfied.
- To realize the potential for reuse of hardware and software, developers must agree on the architectural style and architectural design of the hardware and software that is to be reused. For example, hardware interface specifications must also be agreed upon.
- The replacement of military specifications with commercial specifications and performance-based specifications introduces acquisition process considerations that are not addressed by the JTA for C4I.
- In addition, weapon system technical architectures need to address cultural and institutional changes that look beyond the benefit to a single program to shared benefits across acquisition

programs. There is a need to identify the types of tradeoffs and comparisons that have to be made and measured in order to evaluate the benefits of reuse, faster and less costly technology insertion, and use of standard interfaces versus impacts on performance, schedule, and costs to individual weapon system programs. In addition, a weapon system technical architecture needs to address how the technical architecture itself will be evolved and configuration managed as well as implemented and enforced.

To address such challenges we extended the technical architecture concept to include coverage of issues involving commercial practices, institutional factors, resource needs, and schedule considerations in addition to matters regarding the development and maintenance of the technical architectures.

STRATEGY

In developing necessary extensions of the C4I technical architecture concept to suit the needs of weapon system electronics we have developed an integrated strategy for improving interoperability of weapon system electronics. The strategy has four steps that start with an emphasis on research and testing. As results may warrant, the emphasis shifts to demonstrations and concludes with full implementation across the DoD. The four steps comprising the strategy are:

Step 1. Design a prospective methodology for developing technical architectures for weapon system electronics.

Step 2. Conduct pilot tests and refine the methodology.

Step 3. Conduct further demonstration applications and further refine the methodology.

Step 4. Implement the methodology across all weapon system electronics and to the extent appropriate, integrate the technical architectures.

This draft report describes our results for Step 1 and proposes a plan for Step 2.

Integral to each of these steps is a need to manage the extent and pace of change in a way that recognizes the uncertain nature of outcomes and the great difficulty in estimating the life cycle costs and benefits of change. Difficult as it may be, though, such analysis is crucial to sorting through alternative course of action and gauging the nature, extent, and pace of investments in change.

STEP 1. METHODOLOGY FOR DEVELOPING TECHNICAL ARCHITECTURES FOR WEAPON SYSTEM ELECTRONICS

The proposed methodology is divided into nine sections. Sections 1, 2 and 3 address introductory matters: forming the technical architecture concept, dividing electronics into domains, and establishing the role of the technical architecture. Section 4 deals with how to structure the technical architecture.

Sections 5, 6 and 7 each address one of the tactics the DoD already is employing. Sections 8 and 9 address matters of coordination across Services/agencies and coordination across domains.

Sections 1 Through 3. Introductory Matters

The strategy's methodology is built upon four basic ideas that are developed in the first three sections.

- **Domains.** Divide weapon system electronics into domains comprised of similar equipment and develop a technical architecture for each domain. For example, the following groups of electronics might each constitute a separate domain:
    - Aviation electronics
    - Maritime vessel electronics
    - Ground vehicle electronics
    - Space electronics
- **Separate Method for Each Tactic.** Divide the methodology for developing technical architectures for weapon system electronics into three parts, with one part dedicated to each of DoD's three tactics for improving weapon system interoperability: (1) reduce military specifications, (2) increase reuse, and (3) improve interoperation.
- **Tailor Each Domain's Technical Architecture to Best Address Needs.** Focus a domain's technical architecture on the tactics that will best address the domain's needs for improved interoperability of weapon system electronics.
- **Integrate Technical Architectures.** To the extent that it proves beneficial, integrate technical architectures, or aspects of the technical architectures, across Services/agencies and across domains.

Section 4. Structuring a Domain's Technical Architecture

For domains that require a technical architecture that addresses more than one of the three tactics (reduce military specifications, reuse, and improve interoperation), the domains will need to blend the methods in Sections 5, 6 and 7 to develop their technical architecture.

Section 5. Reducing Military Specifications (Tactic 1)

This part of the method may be applied to any domain. The method provides a process wherein government and industry work together to replace mandatory military specifications with a system of high-level performance-based specifications. This approach allows contractors to use commercial specifications where they are available and appropriate.

Among the past efforts aimed at reducing military specifications, our case studies found that the most extensive effort is one that was commissioned by the Joint Logistics Commanders and conducted for the Joint Aeronautical Commanders. The work was performed by the Joint Aeronautical Commanders Group (JACG). We found the JACG methodology to be the most complete and most useful pathfinder for guiding a domain in the development of a technical architecture aimed at reducing military specifications. It, therefore, forms the basis for this part of the methodology.

Broad adoption of the JACG method, however, will need to address some unresolved issues, some of which are being worked by the JACG. For example, replacing a large volume of military specifications with a few high level performance-based specifications frees designers to make maximum use of commercial equipment and commercial processes to reduce costs. However, depending upon how ownership and documentation of design specifications and technical data packages are handled at each level of design from components up through the total weapon system, the lack of military specifications may make it more difficult for additional suppliers to produce/maintain parts and equipment. If the supplier base is limited in such a fashion, prices for production and support could be affected, adversely. To avoid that, it may be necessary to pay the full cost of research and development and buy the technical data packages. Because such actions also are costly, each domain must consider the tactic of reducing military specifications with great care.

Section 6. Increasing Reuse of Hardware and Software (Tactic 2)

This part of the methodology also may be applied to any domain. Our case studies of past efforts aimed at increasing reuse found two contenders for the role of serving as the pathfinder method for this part of the methodology.

One effort that tried to increase the reuse of hardware and software was the Joint Integrated Avionics Working Group's (JIAWG) development of an architecture for the use of common electronic modules. Originally, the modules were intended for joint use by an A-12 (Navy), the F-22 (Air Force,) and the RAH-66 (Army). The Navy dropped out of the effort due to schedule conflicts that were encountered prior to the A-12's termination. Although the Air Force and the Army continued the effort, the concept of using common modules floundered. Designing the modules to handle the different vibrations encountered in each Service's application would have caused higher production costs than would be the case if each Service had modules designed only for the vibration environment of its application.

A more successful facilitation of the reuse of hardware and software has occurred with the commercial transports operated by the major U.S. airlines. A company owned by the airlines is responsible for researching, analyzing, and facilitating the development of the common architectures and associated interface specifications and standards that provide the opportunities for multiple suppliers and reuse. The company, founded in 1929, is known as ARINC (Aeronautical Radio Incorporated). The ARINC processes for facilitating reuse seems to offer the most promising pathfinder model for domains that need to develop a technical architecture aimed at improving reuse. The ARINC processes provide the basis for this part of the methodology.

The ARINC methodology uses two sets of people. One is a committee of airline and industry experts who are responsible for developing an architecture or equipment specification (for hardware or software). The second group are the ARINC employees who provide technical support to the committee and generally facilitate the committee's work. The committee typically meets quarterly and produces a new specification in about a year. An architecture, such as the current modular avionics architecture takes considerably more research by ARINC's staff and more analysis by the airlines and industry. That architecture took seven years to achieve the necessary consensus.

Adapting this ARINC methodology to military electronics raises a number of issues that will need to be addressed. Not the least of which is the matter of what should DoD create/designate as a counterpart to the ARINC organization? Further, how should the front-end investment in developing architectures and standards be funded? And, even more fundamentally, how should tradeoff analyses of the prospective desirability of reuse be directed and funded? Notwithstanding such questions, the ARINC methodology seems to offer the most promise for serving as a pathfinder for increasing reuse.

Section 7. Improving Interoperation (Tactic 3)

This part of the methodology also may be applied to any domain.

Many efforts in recent years have focused on improving interoperation. Our case studies researched the development of the Technical Architecture Framework for Information Management (TAFIM), the National Institute for Standards and Technology (NIST) Application Portability Profile, the Defense Information Infrastructure Common Operating Environment (DII COE), the Army Technical Architecture (ATA) for information systems, and the Joint Technical Architecture (JTA) for C4I information management systems. By virtue of its scope and depth, the JTA for C4I appears to offer the most promising pathfinder model for domains that need to develop a technical architecture aimed at improving interoperation.

Weapon system domains may need to augment their adoption of the C4I JTA method, however, to address additional matters such as how they will develop hardware and software for improving interoperation. For example, they may need to implement not only the provisions specified by the C4I JTA, but they may also want to do so in a manner that minimizes their joint costs by reusing hardware and software.

Section 8. Coordinating Technical Architectures Across Services/Agencies

To develop, evolve, maintain, and apply a technical architecture for weapon systems electronics in a domain (such as aviation electronics), five things are necessary:

- **Coordination.** A Domain Technical Architecture Committee (DTAC) could be formed to oversee coordination. Such a committee should include representatives from weapon system program offices, the Program Executive Office(s), and the Services'/defense agencies' acquisition organizations.
- **Technical Support.** Research, analysis (e.g., tradeoff studies), and facilitation efforts would need to be provided to support the DTAC. Such technical support could be provided by what we refer to herein as a Defense Systems Technical Support Contractor (DSTSC).
- **Investment.** Investments are needed to develop, evolve, mature, and maintain the technical architecture for a domain. Because resources for such investments do not now exist, additional funding and management for such funding would need to be arranged.
- **Tactics Selection.** Because the development and application of a technical architecture requires investment of resources, it is important to select the most worthwhile tactics for each domain's technical architecture.
- **Oversight.** Funding of the research and tradeoff studies required to support the development of technical architectures will require management oversight, as will the development and application of the technical architecture for the domain's weapon system electronics.

To coordinate the development of technical architectures across Services, we considered two options.

- Option 1 is a bottom-up approach; most of the responsibility and authority for technical architectures would be delegated to the Services/defense agencies.
- Option 2 is a top-down approach; much of the responsibility and authority would reside at the OSD level.

With each option, somebody must have the responsibility and authority to (1) create the incentives for change, (2) set the nature, extent, and pace of change, (3) monitor outcomes, and (4) make needed adaptations as knowledge is accumulated.

Bottom-Up Approach to Coordination (Option 1). This approach would delegate to a single Service or defense agency the lead responsibility[3] for developing, modifying, maintaining, and maturing a domain's technical architecture. For example, the Services might divide responsibilities for weapon systems electronics domains in the following way

- The Army might be the lead Service for rotary wing aviation, munitions, land vehicles, and soldier systems.
- The Navy might be the lead Service for maritime vessels, tactical missiles, surveillance/reconnaissance, and automatic test equipment.
- The Air Force might be the lead Service for fixed wing aviation, strategic missiles, missile defense, and space vehicles.

For each domain it would be up to the lead Service/agency to devise appropriate mechanisms for working with the other Services/agencies in the domain. Arrangements for technical support for the domain would be handled by the lead Service/agency through its acquisition organization. Funding of contractor support for the domain would be handled through the POM process by the lead Service/agency. Tactics selection would be handled by the domain's representatives under the direction of the lead Service/agency. The participants would be responsible for understanding the needs of the operational communities that they serve. Responsibility for the enforcement of the technical architecture would reside with the acquisition executive for each Service/agency.[4]

With this option OSD mainly plays a policy role. In that role it would direct the Services and the defense agencies to

- Define domains/subdomains[5] for DoD's weapon systems electronics.
- Assign lead responsibilities to the Services/defense agencies for the domains.
- Develop a technical architecture for each domain/subdomain.

[3]One might think that a true bottom-up approach would have each Service/agency establish and manage its own domain. Such an approach, however, does not address what many people see as a need to coordinate across Services/agencies.

[4]The Corporate Information Officer for each Service/agency may also have a role.

[5]The creation of subdomains that may be under a domain creates the need for interfaces between technical architectures. The cost effectiveness of introducing such subdomains needs to be examined in the instance of each domain.

- Use the technical architectures in developing new weapon systems and in developing modifications for existing weapon systems.
- Monitor the use of the technical architectures during the acquisition/modification process.
- Hold the Service/agency's acquisition executive responsible for the Service's/agency's participation in the building and use of technical architectures.
- Give the acquisition executive the authority and resources to task the Service's/agency's acquisition organizations for assistance related to the building and use of technical architectures.

OSD would also play an educational role by providing ideas and methods about how the Services and defense agencies might develop their technical architectures.

Top-Down Approach to Coordination (Option 2). This approach would delegate to an OSD organization (or an OSD committee) the responsibility for overseeing the development, validation, evolution, modification, maintenance, and maturation of each domain's technical architecture. It would be up to this organization to define/approve domain definitions and the mechanism for how Services/agencies would coordinate their technical architecture work. Funding arrangements for technical support for the domains would be handled by this organization, as would the needs for other funding arrangements to support necessary front-end investments. Tactics selection would be handled by this OSD organization, as would responsibility for the enforcement of the technical architectures. With this option OSD plays both a policy role and an operational role.

Following are some ideas for one way in which OSD might implement such a role.

- **Involve Combatant CINCs and Joint Staff in Focusing Efforts.** To help assure that the aspects of interoperability that most need improvement are addressed by a technical architecture, the Combatant CINCs and the Joint Staff would be involved in defining and prioritizing needed improvements.
- **Form a Defense Systems Interoperability Board.** A committee or group such as a Defense Systems Interoperability Board (DSIB) could serve as an intermediary between the DTACs and the Combatant CINCs and the Joint Staff and provide the functions of the aforementioned OSD committee.
- **Use a DSIB to Help Review Acquisition Programs.** Involving the DSIB in milestone reviews for acquisition programs would provide an opportunity to assess the suitability of progress in achieving the three aspects of DoD's interoperability goal (insert new technology, reduce costs, and improve interoperation).

- **Use a DSIB to Assess Interoperability Performance.** To provide the DoD an assessment of current interoperability performance, a DSIB could produce a periodic assessment that would be provided to the Combatant CINCs and the Joint Staff to facilitate their assessment of needed improvements and priorities for improvement. Such a DSIB assessment, along with the assessments of prioritized needs could be used to facilitate milestone reviews for acquisition programs.
- **Require DSIB Approval of Domain Technical Architectures for Weapon System Electronics.** To assure quality, consistency, and timeliness in the development of these technical architectures, the DoD could require DSIB approval of these domain architectures. The DoD could also make the DSIB responsible for the DoD's methodology for developing technical architectures for weapon system electronics.
- **Provide Technical Support for a DSIB.** To enable a DSIB to carry out the aforementioned functions, the DoD would need to provide long-term technical support for the DSIB. One way that this might be accomplished is to form a small administrative staff within DoD, supplemented by a Federally Funded Research and Development Contractor that would commit to supporting the technical expertise that a DSIB would require. Mitre and Aerospace are examples of existing FFRDCs that might provide a good match for such support.

Section 9. Integrating Technical Architectures Across Domains

As weapon systems electronics is divided into domains, and as technical architectures are developed for each domain, certain similarities in the architectures may become apparent. In some instances there may be value added from integrating certain aspects of the architectures to form a product that may be applicable across many domains. Under Option 1, a lead Service and its technical support organization might be designated to fulfill the job of coordination. Under Option 2, a DSIB and its technical support organization -- perhaps an FFRDC -- could facilitate the identification of such opportunities and the development of an appropriate technical approach.

Because policy makers may find that the top-down approach has features that they want to add to the bottom-up approach, there is the possibility of a hybrid approach that includes some combination of Options 1 and 2.

STEP 2. PILOT TEST

A pilot test of the methodology for developing technical architectures for domains of weapon system electronics could be divided into four phases: prepare for the pilot test, execute the test, analyze the test results, and refine the method for developing technical architectures for weapon system electronics. Preparation for such a test should include:

- Develop support within OSD (A&T, and C3I) and the Joint Staff for the concept of a pilot test.
- Develop a specific concept for the test objectives, scope, and domains.
- Develop a test plan with the participants.
- Arrange for test support from DoD organizations and a technical support contractor.

The extent of participation by DoD organizations depends upon the test objectives and the scope that is established for the test. Ideally, the test would exercise all of the elements of the prospective methodology in ways that prepare each element to participate in the strategy's Step 3 demonstration of the methodology to additional domains.

Development of the Technical Architecture. A Domain Technical Architecture Committee -- with a strong position for the chairperson -- would include representatives from participating acquisition programs and Service/defense agency acquisition organizations. Such a committee would need a Domain Technical Support Contractor or a government organization to provide necessary technical support.

Guidance. Under Option 1, guidance would come from the participating Services and defense agencies. Under Option 2, guidance would come from a Defense Systems Interoperability Board that would provide priorities for tactics to the Domain Technical Architecture Committees. Such guidance would be developed in consultation with the Combatant CINCs and the Joint Staff. A Defense Systems Interoperability Council -- including industry representation -- would provide technical input to the Defense Systems Interoperability Board.

Facilitation and Evaluation. To help facilitate the test, the Under Secretary for Acquisition and Technology would play an active role in approving the test concept and the test plan and in reviewing progress. Assistance in facilitation and evaluation also would come from participating Services and defense agencies, an interoperability oriented FFRDC(s), and a Joint Test Team that would be formed to facilitate and evaluate the test.

CONCLUSIONS

Achieving significant progress in improving interoperability of weapon system electronics requires significant effort to coordinate and integrate the actions required of numerous DoD organizations. To best invest such effort, needs for improved interoperability must be assessed and tradeoff analyses must identify where such effort might best be focused. The technical architecture concept developed for the C4I JTA offers much promise for helping to improve C4I information management systems. Extending the concept to weapon systems electronics also appears to offer promise. A pilot test of such an extension seems to be warranted in view of the potentially substantial benefit. Such a test will require significant preparation and high level support within OSD to assure appropriate participation by DoD organizations.

NEXT STEPS

The research sponsor will decide whether the proposed methodology offers sufficient potential to warrant further consideration. If so, the next question is whether the current draft provides a sufficient basis for commencing preparations for a pilot test. Although we would prefer further research and a more polished report prior to taking such a next step, we recognize that much would be learned from a pilot test that research alone would be unlikely to discover. A balanced approach might include a combination of (1) preparing for the pilot test, (2) obtaining feedback on the current draft, (3) refining the methodology, and (4) researching issues that arise along the way.